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(54) **RACK TYPE ELECTRIC POWER STEERING APPARATUS**

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(71) Applicant: **MANDO CORPORATION**,  
Pyeongtaek-si, Gyeonggi-do (KR)

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(72) Inventor: **Hee Kwon Jo**, Yongin-si (KR)

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(73) Assignee: **MANDO CORPORATION**,  
Pyeongtaek-si (KR)

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U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **14/992,004**

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Primary Examiner — Tony Winner

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(74) Attorney, Agent, or Firm — Hauptman Ham, LLP

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(30) **Foreign Application Priority Data**

(57) **ABSTRACT**

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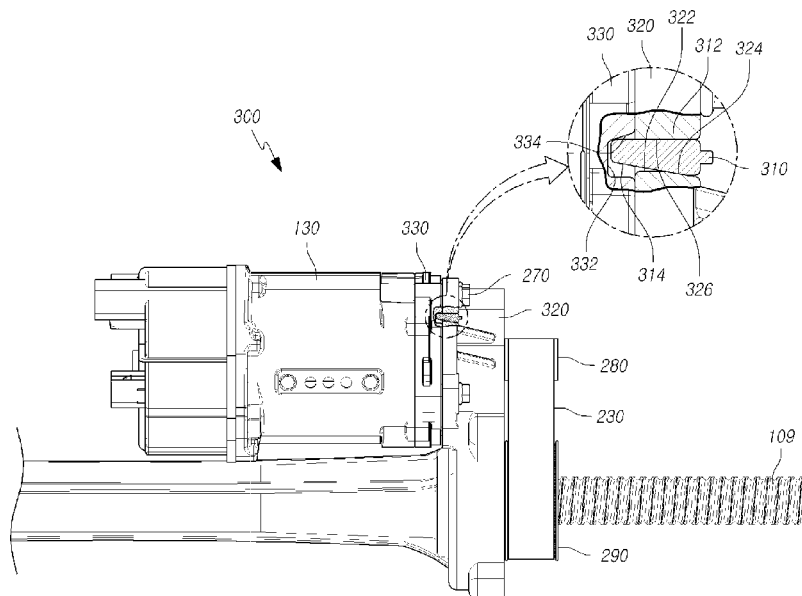
A power steering system having the tensional force of a belt becomes higher as the distance between a motor shaft and a rack bar becomes larger because a second inclined portion of a support body passing through a guide hole is moved upwards along a first inclined portion to be inserted into a coupling recess, and accordingly, noise and damage to the belt can be prevented. If the support body is inserted into the coupling recess by a third inclined portion of a coupling recess and a motor housing is moved upwards, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger and, accordingly, noise and damage to the belt can be prevented.

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**B62D 3/12** (2006.01)

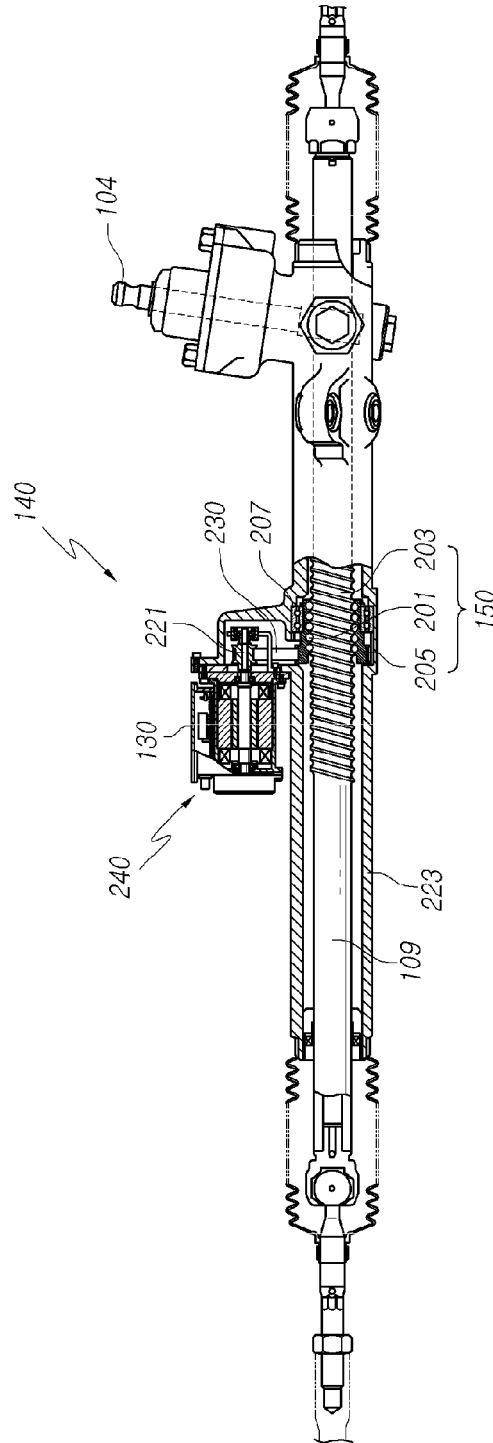
(52) **U.S. Cl.**  
CPC ..... **B62D 5/0403** (2013.01); **B62D 3/12**  
(2013.01); **B62D 5/0424** (2013.01)

(58) **Field of Classification Search**  
CPC ..... B62D 5/0403; B62D 5/04  
USPC ..... 180/444; 474/101  
See application file for complete search history.

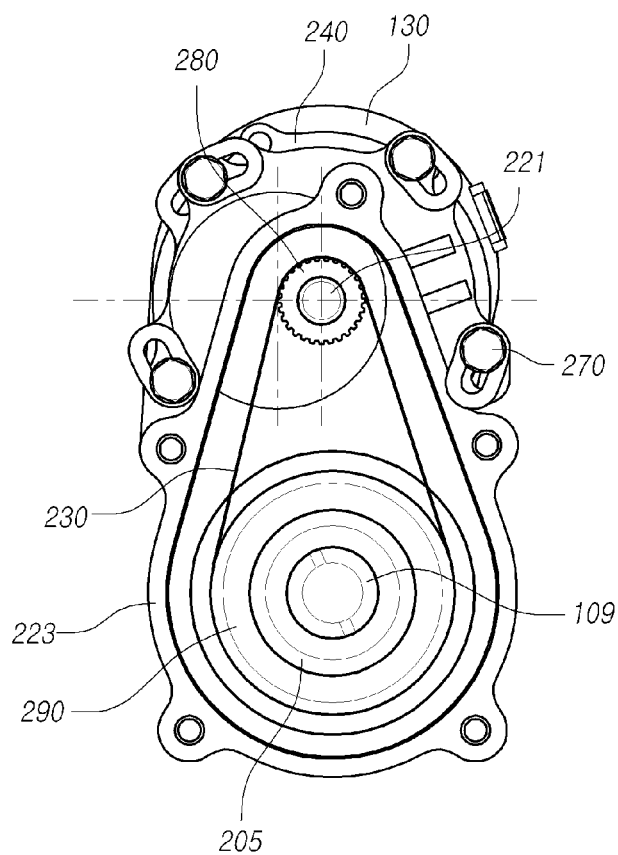
**10 Claims, 9 Drawing Sheets**



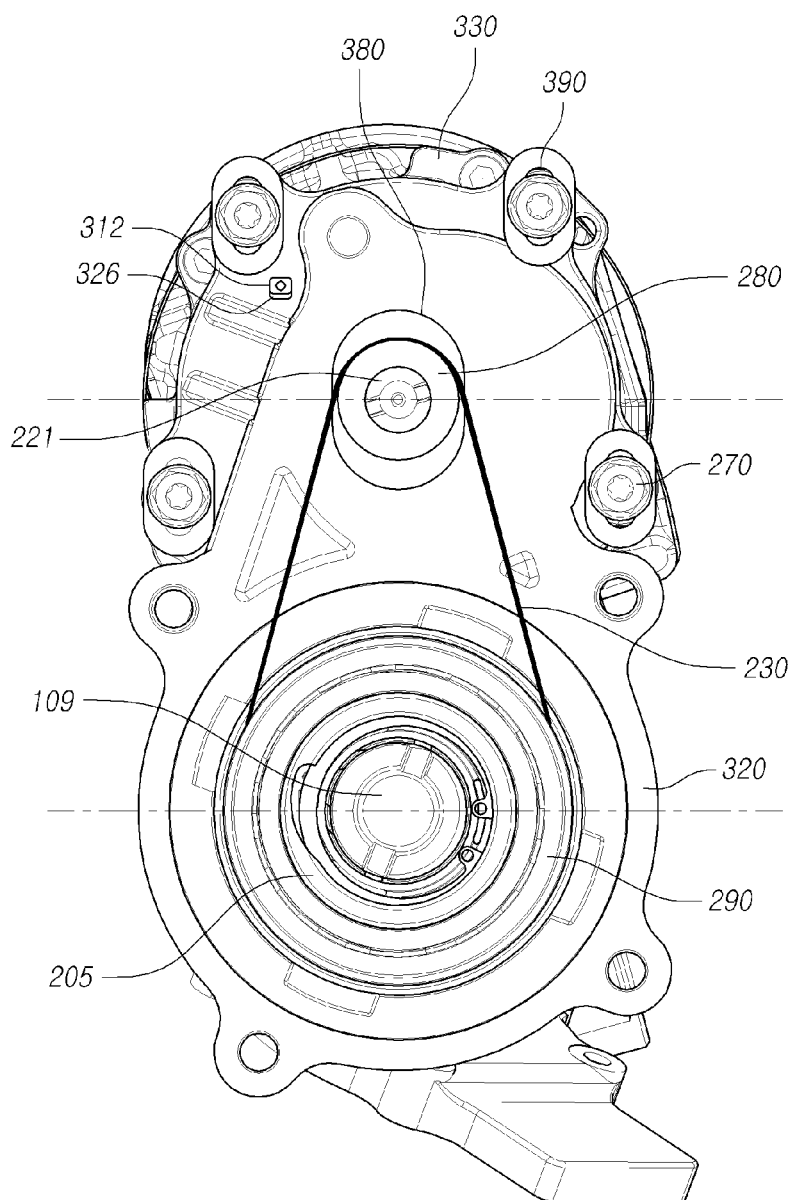
**FIG. 1**  
PRIOR ART

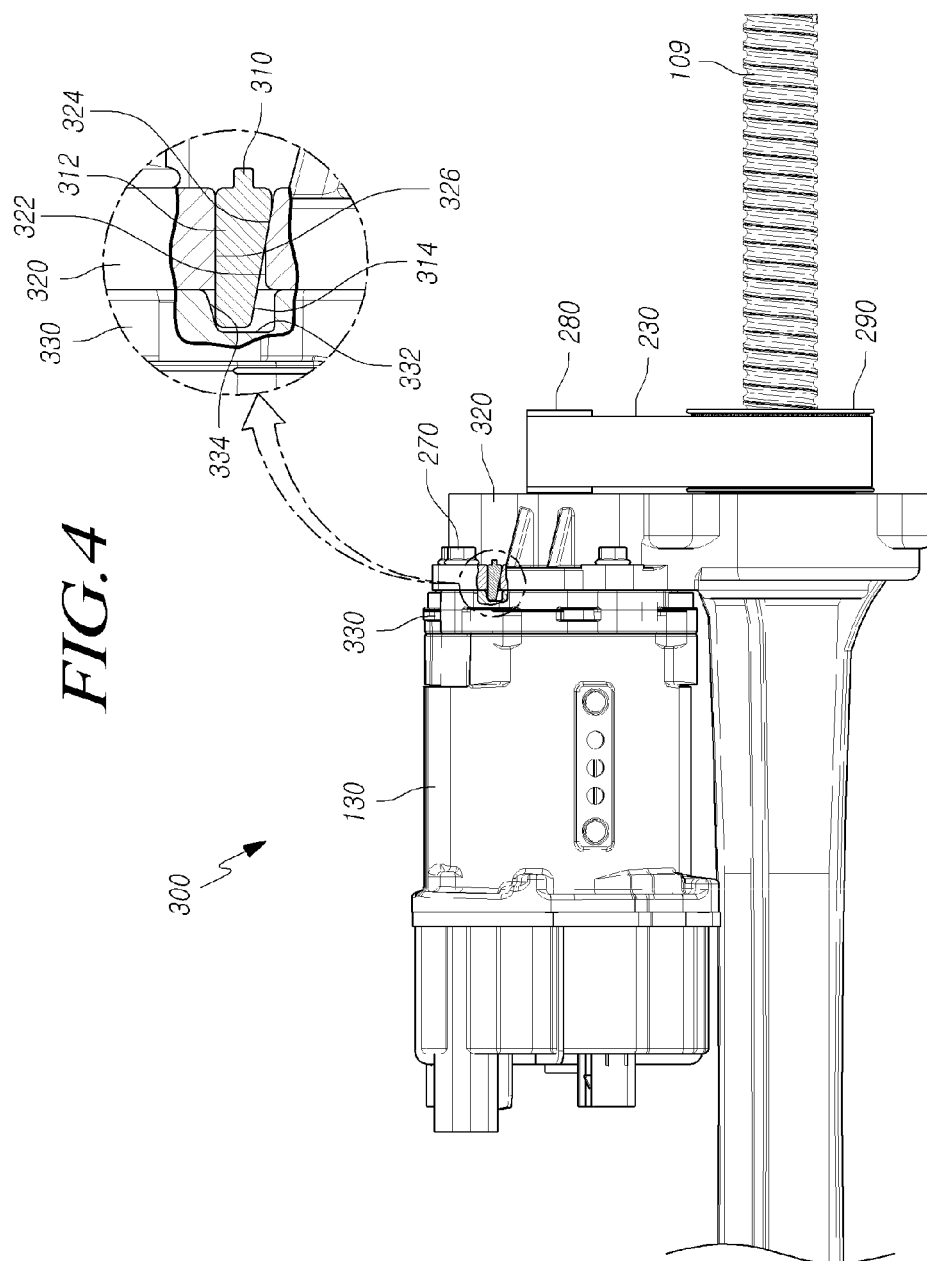


**FIG. 2**  
*PRIOR ART*

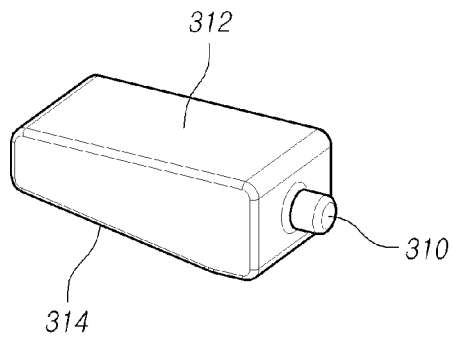


*FIG. 3*

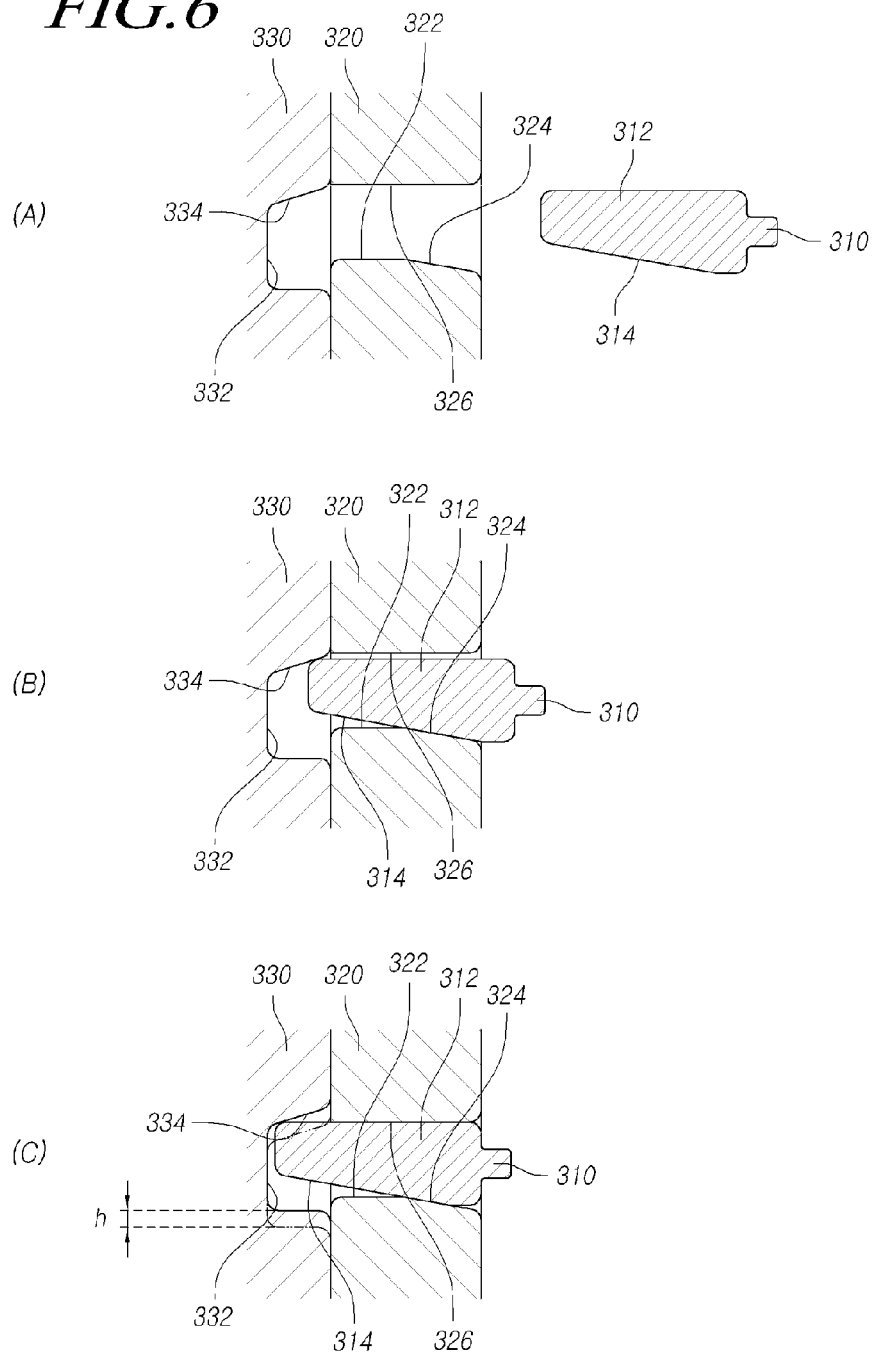




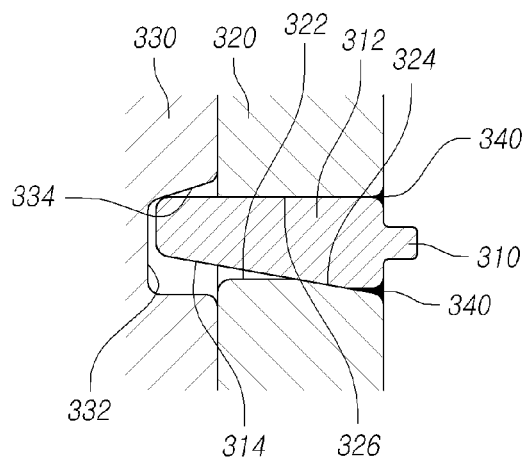
*FIG. 5*



**FIG. 6**

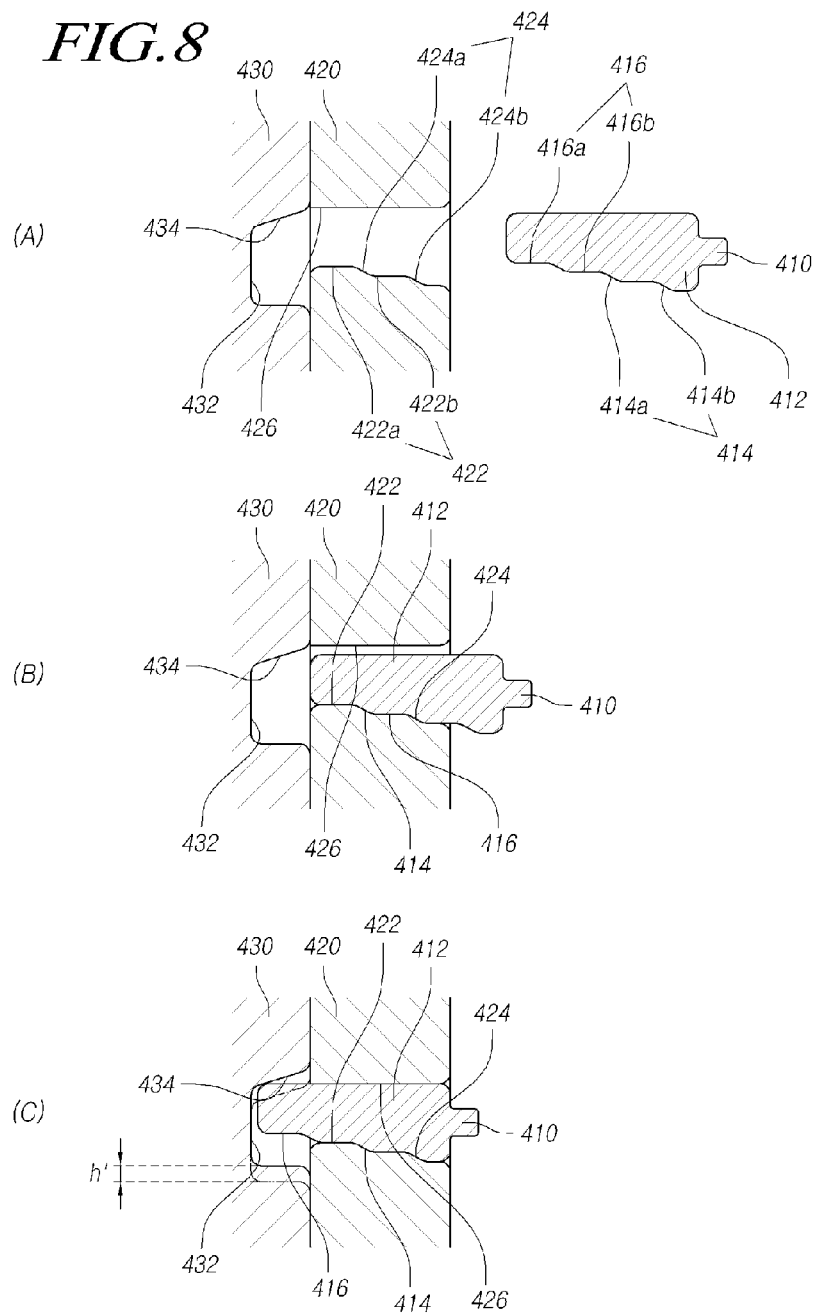


*FIG. 7*

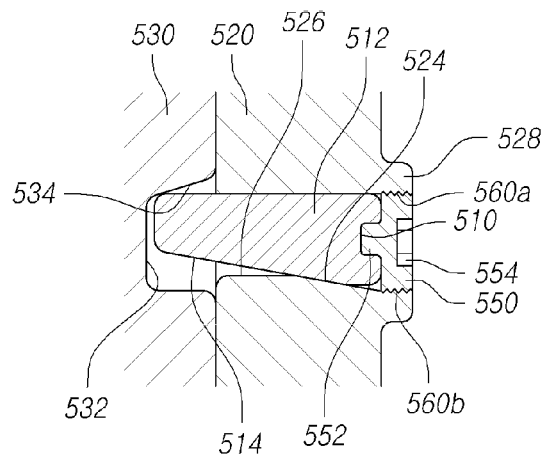




**FIG. 8**



*FIG. 9*



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# RACK TYPE ELECTRIC POWER STEERING APPARATUS

## CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from and the benefit under 35 U.S.C. §119(a) of Korean Patent Application No. 10-2015-0004007, filed on Jan. 12, 2015, which is hereby incorporated by reference for all purposes as if fully set forth herein.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a rack type electric power steering apparatus. More particularly, it relates to a rack type electric power steering apparatus in which the tensional force of a belt becomes higher as the distance between a motor shaft and a rack bar becomes larger because a second inclined portion of a support body passing through a guide hole is moved upwards along a first inclined portion to be inserted into a coupling recess, and accordingly, noise and damage to the belt can be prevented. Further, if the support body is inserted into a coupling recess by a third inclined portion of a coupling recess and a motor housing is moved upwards, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger, and accordingly, noise and damage to the belt can be prevented.

### 2. Description of the Prior Art

In general, a steering apparatus refers an apparatus that allows the driver to rotate a steering wheel to freely change the direction of travel of a vehicle, and is an apparatus that arbitrarily changes the center of rotation about which the front wheels are pivoted to help the driver drive the vehicle in a desired direction.

FIG. 1 is a partially sectional view of a rack type electric power steering apparatus according to the related art.

As illustrated in FIG. 1, the rack type electric steering apparatus, according to the related art, includes a rack bar 109 that extends in a transverse direction of a vehicle and has a rack gear part on one side of an outer peripheral surface thereof, a pinion shaft 104 that has a pinion gear part that is engaged with the rack gear part, a ball screw part 150 that has balls 201, a ball screw 203, and a ball nut 205 engaged with the ball screw 203 via the balls 201, a belt type transmission unit 140 that connects the ball nut 205 and a motor shaft 221, a motor 130, and a motor housing 240 that is fixed to a rack housing 223 through bolt coupling while surrounding the motor 130.

The pinion shaft 104 is connected to a steering wheel through a steering shaft, and the rack bar 109 that has a screw of a predetermined length on one side of an outer surface thereof is installed within the rack housing 223.

The ball screw part 150 includes a ball nut 205, which is coaxially formed with the rack bar 109 and surrounds the rack bar 109, and the balls 201 that make contact with the ball screw 203 formed on the outer surface of the rack bar 109.

The ball nut 205 is rotated together with the motor shaft 221 as the motor shaft 221 is rotated, and a bearing 207 is provided between an outer peripheral surface of the ball nut 205 and an inner peripheral surface of the rack housing 223 for the smooth rotation of the ball nut 205.

The belt type transmission unit 140 includes a belt 230 that connects the motor shaft 221 and the ball nut 205, and transmits auxiliary power that is generated by the motor 130 to the

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rack bar 109 through the ball nut 205 in proportion to a steering torque applied to the steering wheel.

That is, as the motor shaft 221 is rotated, the ball nut 205, which received a rotational force of the motor shaft 221 through the belt 230, is also rotated, and as the ball nut 205 is rotated, the rack bar 109 is axially linearly moved according to the movements of the balls 201 and the ball screw 203.

FIG. 2 is a side view of a motor housing and a rack housing of the rack type electric power steering apparatus according to the related art.

The motor 130 is fixed by coupling the motor housing 240 surrounding the motor 130 and the rack housing 223 by means of bolts 270.

If the motor shaft 221 drives the belt 230 while being rotated to rotate the ball nut 205 during a steering operation, a force that pulls the motor shaft 221 and a shaft of the rack bar 109 including the ball nut 205 towards each other is applied by a tensional force of the belt 230.

Because the generated force is concentrated on a coupling portion of the bolts of the motor housing 240 and the rack housing 223, which is most mechanically vulnerable, and the motor shaft 221 is moved towards the rack bar 109 that includes the ball nut 205 by a phenomenon in which the bolts 300 are released due to vibration and an impact occurring while the motor shaft 221 is rotated during a steering operation, the tensional force of the belt 230 decreases, noise occurs between the belt 230 and a driving pulley 280 or a driven pulley 290, and the belt 230 is damaged.

## SUMMARY OF THE INVENTION

The present invention has been made in an effort to solve the above-mentioned problems, and provides a rack type electric power steering apparatus in which the tensional force of a belt becomes higher as the distance between a motor shaft and a rack bar becomes larger because a second inclined portion of a support body passing through a guide hole is moved upwards along a first inclined portion to be inserted into a coupling recess, and accordingly, noise and damage to the belt can be prevented. Also, if the support body is inserted into a coupling recess by a third inclined portion of a coupling recess and a motor housing is moved upwards, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger and, accordingly, noise and damage to the belt can be prevented.

In order to achieve the object, there is provided a rack type electric power steering apparatus including: a rack housing that surrounds a rack bar coupled to a driven pulley, has a through-hole through which a motor shaft of a motor coupled to a driving pulley passes, has a guide hole that is spaced apart from the through-hole, and has a first inclined portion of which a cross-section in a direction in which the motor is coupled is changed; a motor housing to which the rack housing is coupled, on which the motor is mounted such that the motor shaft passes through the through-hole, and which has a coupling recess at a location corresponding to the guide hole; and a support body that passes through the guide hole to be coupled to the coupling recess and has a second inclined portion corresponding to the first inclined portion such that the driving pulley is moved away from the driven pulley when being coupled.

As described above, according to the present invention, because the second inclined portion of the support body passing through the guide hole is moved upwards along the first inclined portion to be inserted, the tensional force of the belt becomes higher as the distance between the motor shaft and

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the rack bar becomes larger, and accordingly, noise and damage to the belt can be prevented.

Furthermore, if the support body is inserted by the third inclined portion of the coupling recess and the motor housing is moved upwards, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger and, accordingly, noise and damage to the belt can be prevented.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a partially sectional view of a rack type electric power steering apparatus according to the related art;

FIG. 2 is a side view of a motor housing and a rack housing of a rack type electric power steering apparatus according to the related art;

FIG. 3 is a side view of a motor housing and a rack housing of a rack type electric power steering apparatus according to a first embodiment of the present invention;

FIG. 4 is a front view of the motor housing and the rack housing of the rack type electric power steering apparatus according to the first embodiment of the present invention;

FIG. 5 is a perspective view illustrating a support body of the rack type electric power steering apparatus according to the first embodiment of the present invention;

FIG. 6 is a partially sectional view illustrating a process of coupling the support body to the rack housing and the motor housing in the rack type electric power steering apparatus according to the first embodiment of the present invention;

FIG. 7 is a partially sectional view illustrating a state in which the support body is coupled to the rack housing and the motor housing according to the first embodiment of the present invention;

FIG. 8 is a partially sectional view illustrating a process of coupling a support body to a rack housing and a motor housing in a rack type electric power steering apparatus according to a second embodiment of the present invention; and

FIG. 9 is a partially sectional view illustrating a state in which a support body is coupled to a rack housing and a motor housing in a rack type electric power steering apparatus according to a third embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the description of the elements of the present invention, terms "first", "second", "A", "B", "(a)", "(b)" and the like may be used. These terms are merely used to distinguish one structural element from other structural elements, and a property, an order, a sequence and the like of a corresponding structural element are not limited by the term. It should be noted that if it is described in the specification that one component is "connected," "coupled" or "joined" to another component, a third component may be "connected," "coupled," and "joined" between the first and second components, although the first component may be directly connected, coupled or joined to the second component.

Unless otherwise mentioned in the detailed description of the present invention, the upper side of FIG. 4 will be described as an upper side, the lower side of FIG. 4 will be

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described as a lower side, the left side of FIG. 4 will be described as one side, and the right side of FIG. 4 will be described as an opposite side for the convenience of description.

FIG. 3 is a side view of a motor housing and a rack housing of a rack type electric power steering apparatus according to a first embodiment of the present invention. FIG. 4 is a front view of the motor housing and the rack housing of the rack type electric power steering apparatus according to the first embodiment of the present invention. FIG. 5 is a perspective view illustrating a support body of the rack type electric power steering apparatus according to the first embodiment of the present invention. FIG. 6 is a partially sectional view illustrating a process of coupling the support body to the rack housing and the motor housing in the rack type electric power steering apparatus according to the first embodiment of the present invention. FIG. 7 is a partially sectional view illustrating a state in which the support body is coupled to the rack housing and the motor housing according to the first embodiment of the present invention.

Referring to FIGS. 3 to 7, in a detailed description of a feature structure of the first embodiment of the present invention, the rack type electric power steering apparatus, according to the first embodiment of the present invention, includes a rack housing 320 that surrounds a rack bar 109 coupled to a driven pulley 290, has a through-hole 380 through which a motor shaft 221 of a motor 130 coupled to a driving pulley 280 passes in an axial direction of the rack bar 109, and has a guide hole 326 that is spaced apart from the through-hole 380, extending in the axial direction of the rack bar 109, and having a first inclined portion 324 of which a cross-section is changed such that a vertical width thereof in a direction in which a motor 130 is coupled becomes narrower, a motor housing 330 to which the rack housing 320 is coupled, on which the motor 130 is mounted such that the motor shaft 221 passes through the through-hole 380, and which has a coupling recess 332 at a location corresponding to the guide hole 326, and a support body 312 that passes through the guide hole 326 to be coupled to the coupling recess 332 and has a second inclined portion 314 corresponding to the first inclined portion 324 such that the driving pulley 280 is moved away from the driven pulley 290 when being coupled.

A belt type transmission unit 300 includes a driving pulley 280 that is coupled to the motor shaft 221, a driven pulley 290 that is coupled to a ball nut 205, and a belt 230 that connects the driving pulley 280 and the driven pulley 290, and auxiliary power that is generated by the motor 130 in proportion to a steering torque applied to a steering wheel is transmitted to the rack bar 109 through the ball nut 205.

That is, the ball nut 205 that received a rotational force of the motor shaft 221 is also rotated by the belt 230 as the motor shaft 221 is rotated, and the rack bar 109 is axially linearly moved by balls and a ball screw as the ball nut 205 is rotated.

The rack housing 320 surrounds the rack bar 109 to which the driven pulley 290 is coupled, has a through-hole 380 through which the motor shaft 221 of the motor 130 to which the driving pulley 280 is coupled passes in the axial direction of the rack bar 109, and has a guide hole 326 spaced apart from the through-hole 380, extending in the axial direction of the rack bar 109, and having a first inclined portion 324 of which a cross-section is changed such that a vertical width thereof in a direction in which a motor 130 is coupled becomes narrower.

Here, the through-hole 380 may be a slot such that a portion of the motor housing 330 is inserted into the slot and the motor shaft 221 is moved upwards and downwards.

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The guide hole **326** has a first flat portion **322** extending from the first inclined portion **324** and having a constant vertical width in a direction in which the motor **130** is coupled.

That is, the guide hole **326** has a first flat portion **322** that has a constant vertical width on one side on which the motor **130** is coupled, and a first inclined portion **324** of which a vertical width becomes wider as it goes from the first flat portion **322** to an opposite side.

The guide hole **326** has the first inclined portion **324** on any one of the upper surface and the lower surface thereof, and a support body **312** that has a second inclined portion **314** corresponding to the first inclined portion **324** on any one of the upper surface and the lower surface thereof such that the support body **312** to correspond to the guide hole **326** is coupled to the guide hole **326**.

In the first embodiment of the present invention, because the first inclined portion **324** is formed on the lower surface of the guide hole **326** and the second inclined portion **314** is formed on the lower surface of the support body **312** such that the second inclined portion **314** of the support body **312** passing through the guide hole **326** is moved upwards along the first inclined portion **324** of the guide hole **326** to be inserted into the coupling recess **332**, the motor housing **330** is moved upwards such that the distance between the motor shaft **221** and the rack bar **109** becomes larger, increasing the tensional force of the belt **230** and, accordingly, preventing noise and damage to the belt **230**.

The motor **130** is coupled to the motor housing **330** surrounding the motor **130** by bolts.

The motor housing **330** is coupled to the rack housing **320** such that the motor **130** is mounted on the motor housing **330** and the motor shaft **221** passes through the through-hole **380**, and the coupling recess **332** is formed at a location corresponding to the guide hole **326**.

One or more slots **390** are formed in the rack housing **320** such that the driving pulley **280** that is coupled to the motor shaft **221** is moved away from the driven pulley **290** that is coupled to the rack bar **109** and one or more screw holes are formed in the motor housing **330** so that the tensional force of the belt **230** is adjusted by preliminarily coupling the bolts **270** to the screw holes after passing the bolts **270** through the slots **390** and moving the motor housing **330** upwards and downwards, and the motor housing **330** is fixed to the rack housing **320** by fastening the bolts **270** in the state in which the tensional force of the belt **230** is adjusted.

The coupling recess **332** has a third inclined portion **334** on the upper surface thereof such that a vertical width thereof becomes narrower as it goes towards a side on which the motor **130** is coupled.

Accordingly, if the support body **312** is inserted into the coupling recess **332** by the third inclined portion **334** of the coupling recess **332** and the motor housing **330** is moved upwards at the same time, the distance between the motor shaft **221** and the rack bar **109** becomes larger, increasing the tensional force of the belt **230** and, accordingly, preventing noise and damage to the belt **230**.

When the support body **312** passes through the guide hole **326** and is coupled to the coupling recess **332**, the second inclined portion **314** corresponding to the first inclined portion **324** is formed such that driving pulley **280** is moved away from the driven pulley **290**.

That is, the support body **312** has the second inclined portion **314** corresponding to the first inclined portion **324** of the guide hole **326** on any one of the upper surface and the lower surface thereof.

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In addition, the support body **312** has a knob **310** that protrudes from an end in a direction in which a vertical width thereof becomes larger in an axial direction of the rack bar **109**.

In the rack type electric power steering apparatus, according to the first embodiment of the present invention, if the motor housing **330** is preliminarily coupled to the rack housing **320** as illustrated in FIG. 6A and then the support body **312** is inserted into the guide hole **326** of the rack housing **320** as illustrated in FIG. 6B, the support body **312** having the second inclined portion **314** pushes the motor housing **330** upwards along the first inclined portion **324** of the rack housing **320** to be inserted into the guide hole **326**.

As illustrated in FIG. 6C, when the support body **312** is inserted and the motor housing **330** is moved upwards by the third inclined portion **334** of the motor housing **330** at the same time, and the tensional force of the belt **230** is increased in proportion to the distance *h* by which the motor housing **330** is moved along the inclined portion.

Accordingly, because the second inclined portion **314** of the support body **312** passing through the guide hole **326** is moved upwards along the first inclined portion **324** of the guide hole **326** and is inserted into the coupling recess **332**, the motor housing **330** is moved upwards and the distance between the motor shaft **221** and the rack bar **109** becomes larger, increasing the tensional force of the belt **230** and, accordingly, preventing noise and damage to the belt **230**.

If the support body **312** is inserted into the coupling recess **332** by the third inclined portion **334** of the coupling recess **332** and the motor housing **330** is moved upwards at the same time, the tensional force of the belt **230** increases as the distance between the motor shaft **221** and the rack bar **109** increases and, accordingly, noise and damage to the belt **230** can be prevented.

Here, as illustrated in FIG. 7, the inserted support body **312** may be fixed to the rack housing **320** through a fixing method such as bonding **340**, welding, or caulking.

FIG. 8 is a partially sectional view illustrating a process of coupling a support body to a rack housing and a motor housing in a rack type electric power steering apparatus according to a second embodiment of the present invention.

The second embodiment of the present invention is the same as the first embodiment of the present invention except for a guide hole **426** and a support body **412**, and thus only the structures and operations of the guide hole **426** and the support body **412** will be described.

As illustrated, in the rack type electric power steering apparatus, according to the second embodiment of the present invention, two or more first inclined portions **424** and two or more first flat portions **422** formed in the guide hole **426** are sequentially repeatedly formed inwards, and the support body **412** is configured such that second inclined portions **414** and second flat portions **416** are sequentially repeatedly formed to correspond to the first inclined portions **424** and the first flat portions **422**.

That is, in the guide hole **426**, a first flat portion **422a** having a constant vertical width is formed on one side in a direction in which the motor **130** is coupled, a first inclined portion **424a** is formed such that a vertical width thereof becomes larger as it goes from the first flat portion **422a** to an opposite side, and in turn, a first flat portion **422b** is formed from the first inclined portion **424a** to an opposite side and a first inclined portion **424b** is formed from the first flat portion **422b** to an opposite side such that a vertical width thereof becomes larger.

In the guide hole **426**, according to the embodiment of the present invention, three second inclined portions **314** and

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three first flat portions **422** are sequentially repeatedly formed, and also in the support body **412** corresponding to the guide hole **426**, three second inclined portions **414** and three second flat portions **416** are sequentially repeatedly formed.

That is, in the support body **412**, a second flat portion **416a** having a constant vertical width is formed on one side in a direction in which the motor **130** is coupled, a second inclined portion **414a** is formed such that a vertical width thereof becomes larger as it goes from the second flat portion **416a** to an opposite side, and in turn, a second flat portion **416b** is formed from the second inclined portion **414a** to an opposite side and a second inclined portion **414b** is formed such that a vertical width thereof becomes larger from the second flat portion **416b** to an opposite side.

In the guide hole **426** and the support body **412** formed in this way, because the inclined portions **414** and **424** and the flat portions **416** and **422** are repeatedly formed, the tensional force of the belt **230** can be adjusted in stages.

In the rack type electric power steering apparatus, according to the second embodiment of the present invention, if the motor housing **430** is preliminarily coupled to the rack housing **420** as illustrated in FIG. 8A and then the support body **412** is inserted into the guide hole **426** of the rack housing **420** as illustrated in FIG. 8B, the support body **412** having the second inclined portions **414** pushes the motor housing **430** upwards along the first inclined portions **424** of the rack housing **420** to be inserted.

As illustrated in FIG. 8C, the support body **412** is inserted and the motor housing **430** is moved upwards by the third inclined portion **434** of the motor housing **430**, and the tensional force of the belt **230** is increased by the distance *h* by which the motor housing **430** is moved along the inclined portion.

Here, when the tensional force is high, a knob **410** of the support body **412** is pulled to fix the support body **412** to the rack housing **420** such that the upper second inclined portion **414a** is situated at the lower first inclined portion **424b** and the upper second flat portion **416a** is situated at the lower first flat portion **422b**.

FIG. 9 is a partially sectional view illustrating a state in which a support body is coupled to a rack housing and a motor housing in a rack type electric power steering apparatus according to a third embodiment of the present invention.

The third embodiment of the present invention is the same as the first embodiment of the present invention except for a guide hole **526** and a support body **512**, and thus, only the structures and operations of the guide hole **526** and the support body **512** will be described.

As illustrated in FIG. 9, the rack type electric power steering apparatus, according to the third embodiment of the present invention, further includes a fixing part **528** that is coupled to, or formed at, an end in a direction in which a vertical width of the guide hole **526** becomes larger, and a plug **550** that is coupled to the fixing part **528** while supporting the support body **512**.

That is, the fixing part **528** having a female screw portion **560a** is coupled to, or formed at, an end of the guide hole **526** in a direction in which a vertical end thereof becomes larger, and the plug **550** having a male screw portion **560b** is coupled to the female portion **560a** of the fixing part **528** to support the support body **512**.

Alternatively, a male screw portion may be formed in the fixing part **528** and a female screw portion may be formed in the plug **550** so that the plug **550** may be coupled to the fixing part **528** and the plug **550** may be press-fitted with the fixing part **528**.

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Thereafter, a fixing recess **510** is formed on a surface of the support body **512** that faces the plug **550**, and a fixing boss **552** inserted into the fixing recess **510** is formed in the plug **550**.

Accordingly, because the fixing boss **552** of the plug **550** is inserted into the fixing recess **510** of the support body **512**, the support body **512** is supported by the rack housing **520** without being moved, thereby more firmly supporting the motor housing **530**.

Furthermore, because a coupling tool recess **554** is formed on a surface opposite to the surface on which the fixing boss **552** of the plug **550** is formed and a coupling tool is inserted into the coupling tool recess **554** to fix the plug **550**, the plug **550** is firmly fixed to the fixing part **528**.

As described above, according to the present invention, because the second inclined portion of the support body passing through the guide hole is moved upwards along the first inclined portion to be inserted into the coupling recess, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger, and accordingly, noise and damage to the belt can be prevented.

Furthermore, if the support body is inserted into the coupling recess by the third inclined portion of the coupling recess and the motor housing is moved upwards, the tensional force of the belt becomes higher as the distance between the motor shaft and the rack bar becomes larger and, accordingly, noise and damage to the belt can be prevented.

Even if it was described above that all of the components of an embodiment of the present invention are coupled as a single unit or coupled to be operated as a single unit, the present invention is not necessarily limited to such an embodiment. That is, at least two elements of all structural elements may be selectively joined and operate without departing from the scope of the present invention. Although a preferred embodiment of the present invention has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims. The scope of the present invention shall be construed on the basis of the accompanying claims in such a manner that all of the technical ideas included within the scope equivalent to the claims belong to the present invention.

What is claimed is:

1. A electric power steering apparatus comprising:

a rack housing that surrounds a rack bar that is coupled to a driven pulley, has a through-hole through which a motor shaft of a motor coupled to a driving pulley passes, and has a guide hole that is spaced apart from the through-hole, and having a first inclined portion of which a cross-section in a direction in which the motor is coupled is changed;

a motor housing to which the rack housing is coupled, on which the motor is mounted such that the motor shaft passes through the through-hole, and which has a coupling recess at a location corresponding to the guide hole; and

a support body that passes through the guide hole to be coupled to the coupling recess and has a second inclined portion corresponding to the first inclined portion such that the driving pulley is moved away from the driven pulley when being coupled.

2. The electric power steering apparatus of claim 1, wherein the through-hole is a slot that extends upwards and downwards such that the motor shaft is moved upwards and downwards.

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3. The electric power steering apparatus of claim 1, wherein the guide hole is configured such that a first flat portion having a constant vertical width is formed from the first inclined portion to a side on which the motor is coupled.

4. The electric power steering apparatus of claim 3, wherein two or more first inclined portions and two or more first flat portions formed in the guide hole are sequentially repeatedly formed inwards, and the support body is configured such that second inclined portions and second flat portions are sequentially repeatedly formed to correspond to the first inclined portions and the first flat portions.

5. The electric power steering apparatus of claim 1, wherein the guide hole has the first inclined portion on any one of the upper surface and the lower surface thereof, and a support body that has a second inclined portion corresponding to the first inclined portion on any one of the upper surface and the lower surface thereof such that the support body corresponds to the guide hole.

6. The electric power steering apparatus of claim 1, wherein the coupling recess has a third inclined portion on an upper surface thereof such that a vertical width thereof becomes narrower as it goes towards a side on which the motor is coupled.

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7. The electric power steering apparatus of claim 1, further comprising:

a fixing part that is coupled to, or formed at, an end in a direction in which a vertical width of the guide hole becomes larger; and

a plug that is coupled to the fixing part while supporting the support body.

8. The electric power steering apparatus of claim 7, wherein screw parts are formed on an inner peripheral surface of the fixing part and an outer peripheral surface of the plug such that the plug is screw-coupled to the fixing part.

9. The electric power steering apparatus of claim 7, wherein the support body is configured such that a fixing recess is formed on a surface thereof that faces the plug, and a fixing boss inserted into the fixing recess is formed in the plug.

10. The electric power steering apparatus of claim 1, wherein the support body is configured such that a knob protrudes from an end in a direction in which a vertical width thereof becomes larger, in an axial direction of the rack bar.

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